LIBRARY
APR 10 1922
IV. OF MICH.

APR 10 1922

SCIENCE

NEW SERIES
VOL. LV, No. 1423

FRIDAY, APRIL 7, 1922

SINGLE COPIES, 15 CTS.
ANNUAL SUBSCRIPTION, $6.00

Books for Veterinarians

SISSON—

Anatomy of Domestic Animals. By SEPTIMUS SISSON, S. B., V. S,, Professor of Comparative Anatomy in Ohio State University. Octavo of 930 pages, with 725 illustrations, many in colors. *Second Edition.* Cloth, $12.00 net.

BUCHANAN AND MURRAY—

Veterinary Bacteriology. A Treatise on the Bacteria, Yeasts, Molds, and Protozoa Pathogenic for Domestic Animals. By ROBERT E. BUCHANAN, Ph. D., Professor of Bacteriology; and CHARLES MURRAY, B. Sc., D. V. M., Associate Professor of Veterinary Bacteriology, Iowa State College of Agriculture and Mechanic Arts. Octavo of 600 pages, illustrated. *Second Edition.* Cloth, $4.00 net.

HADLEY—

Veterinary Science. By FREDERICK B. HADLEY, D. V. M., Professor of Veterinary Science, University of Wisconsin. 12mo of 420 pages, illustrated. Cloth, $3.00 net.

HADLEY—

The Horse in Health and Disease. By FREDERICK B. HADLEY, D. V. M,, Professor of Veterinary Science, University of Wisconsin. 12mo of 261 pages, illustrated. Cloth, $1.50 net.

HEINEMAN—

Milk. By PAUL G. HEINEMAN, M. D., Wisconsin. Octavo of 684 pages, illustrated. Cloth, $7.00 net.

KAUPP—

Anatomy of the Domestic Fowl. By B. F. KAUPP, M. S., D. V. M., Poultry Investigator and Pathologist, North Carolina Experiment Station. 12mo of 373 pages, illustrated. Cloth, $3.50 net.

KAUPP—

Poultry Culture, Sanitation, and Hygiene. By B. F. KAUPP, M. S., D. V, M., Poultry Investigator and Pathologist, North Carolina Experiment Station. 12mo of 573 pages, with 200 illustrations. *Second Edition.* Cloth, $3.00 net.

SHARP—

Ophthalmology for Veterinarians. By WALTER N. SHARP, M. D., Professor of Ophthalmology in the Indiana Veterinary College. 12mo of 210 pages, illustrated. Cloth, $2.00 net.

LYNCH—

Diseases of the Swine. By CHARLES L. LYNCH, M. D., D. V. S. Chapter on *Castration and Spaying* by GEORGE R. WHITE, M. D., D. V. S. Octavo of 741 pages, illustrated. Cloth, $5.00 net.

DIETRICH—

Livestock on the Farm. By WILLIAM DIETRICH, B. S. A., M. S,, Head of the Department of Animal and Dairy Husbandry, University of Minnesota, Crookston Branch. 12mo of 269 pages, illustrated. Cloth, $1.75 net.

.....SIGN AND MAIL THIS ORDER FORM TODAY.....

W. B. SAUNDERS COMPANY, West Washington Sq., Phila.

PLEASE SEND ME THE BOOKS CHECKED (√) AND CHARGE TO MY ACCOUNT:—

Sisson's Anatomy of Domestic Animals.....$12.00 net
Buchanan and Murray's Veterinary Bacteriology, $4.00 net
Hadley's Veterinary Science.....$3.00 net
Hadley's Horse in Health and Disease.....$1.50 net
Heineman on Milk .....$7.00 net
Kaupp's Anatomy of the Domestic Fowl.....$3.50 net
Kaupp's Poultry Culture.....$3.00 net
Sharp's Ophthalmology for Veterinarians.....$2.00 net
Lynch's Diseases of the Swine.....$5.00 net
Dietrich's Livestock on the Farm.....$1.75 net

NAME.....

ADDRESS.....

New Texts

CUMMER—A Manual of Clinical Laboratory Methods *New*

IN this, the newest book on the subject, clinical laboratory methods are presented in concise and accessible form. While devoted largely to description of methods, thorough attention is given to the underlying principles, the indications for performing tests and the significance of the results. In most chapters the plan is as follows. (1) Outline of routine examinations; (2) description of the simple qualitative methods which are frequently employed; (3) description of quantitative methods or those of intricate technic; (4) discussion of findings in various morbid conditions. When several methods are given, usually the preferred one is indicated. The method of counting blood cells has been given meticulously, and special attention has been given to the histology and pathology of the blood. Chemical examination of the blood and urine and the relations of urine examinations to life insurance are also treated very fully. The section on Serum Reactions is, in effect a monograph on the Widal, Wassermann and related tests. The liberal use of cross references in the body of the text and the synoptic résumés of quantitative procedures in the chapters on Blood and Urine greatly facilitate the use of the book in the clinical laboratory.

Chapter Headings: Examination of the Blood—Examination of Urine—Examination of Gastric and Duodenal Contents—Examination of the Feces—Examination of Sputum—Examination of Body Exudates, Fluids and Miscellaneous Methods—Bacteriological Methods—Appendix (Equipment, Stains, Vaccines—examination of a large number of specimens, etc.).

By CLYDE LOTTRIDGE CUMMER, Ph.B., M.D., Associate Professor of Clinical Pathology, Western Reserve University; Associate Clinical Pathologist, Lakeside Hospital; Director of Medicine, St. John's Hospital; Director of Laboratories, St. Alexis Hospital, etc., Cleveland. Octavo, 484 pages with 136 engravings and 8 plates. Cloth, $5.50, net.

MANSFIELD on BOTANY—Developmental and Descriptive *New*

A NEW TEXT by a distinguished authority which, because it deals with the two most interesting phases of botany, will achieve the very desirable effect of securing the student's earnest attention. The text is complete and with a logical arrangement that will appeal to all teachers of the subject and is largely illustrated with photographs from Nature.

By WILLIAM MANSFIELD, A.M., Phar.D., Dean and Professor of Botany and Pharmacognosy, Union University, Albany College of Pharmacy, Albany, New York. 12mo. 232 pages, with 135 illustrations. Cloth, $2.50, net.

KENDALL—Bacteriology, General, Pathological and Intestinal *New (2nd) Edition*

ONE of the achievements of the Great War is a noteworthy advance in the Science of Bacteriology. This is manifested not only in marked improvements in methods of investigation and in modifications of preëxisting views in the important fields of Infection and Prevention of many diseases, but also in a complete revision of some of the more important groups of bacteria. Prominent among these is the great class of anaërobic bacilli. During the war period, furthermore, much additional information has accumulated pertinent to diseases which have hitherto been elusive. These developments have necessitated the rewriting of entire sections of this book, and extensive changes and additions to nearly every chapter. Indeed, including the anaërobes and the work on spiral organisms, this new edition contains as much as any volume in existence of the worth-while war and post-war work.

The text retains that characteristic which contributed so largely to the success of its first edition, namely, *dynamic interpretation* of the subject. The author emphasizes throughout *what bacteria do* rather than *what they are*—how they get into the tissues—what they feed on—what they excrete—how they multiply—how they escape from the body—the chemistry of bacterial activity.

New methods of handling bacteria, methods which are improvements over earlier ones, details of laboratory equipment, the minutiæ of technic and the use and value of apparatus are carefully consdered. Much space is given to the discussion of the applications of bacteriology in Etiology and Preventive Medicine, as well as Serology and Vaccine therapy.

By ARTHUR I. KENDALL, Ph.D., Dr. P.H., Professor of Bacteriology, Northwestern University Medical School, Chicago. Octavo. 680 pages, with 99 engravings and 8 plates. Cloth, $6.00, net.

706-8-10 Sansom St., **LEA & FEBIGER** PHILADELPHIA

Send me books checked (X): ☐ Cummer, $5.50; ☐ Mansfield, $2.50; ☐ Kendall, $6.00

SIGNED ..... Sc. 4-22

SCIENCE

A Weekly Journal devoted to the Advancement of Science, publishing the official notices and proceedings of the American Association for the Advancement of Science, edited by J. McKeen Cattell and published every Friday by

THE SCIENCE PRESS

11 Liberty St., Utica, N. Y. Garrison, N. Y.

New York City: Grand Central Terminal

Single Copies, 15 Cts. Annual Subscription, $6.00

Entered as second-class matter January 21, 1922, at the Post Office at Utica, N. Y., under the Act of March 3, 1879.

VOL. LV APRIL 7, 1922 No. 1423

The Early Training of Scientists: PROFESSOR JOEL H. HILDEBRAND..... 355

Are Iodides Food: PROFESSOR J. F. CLENDON 358

Geography as a Profession: DR. H. P. LITTLE 362

Vienna: PROFESSOR C.-E. A. WINSLOW..... 363

Scientific Events:

Mexican Archeology; The Royal Agricultural Society of England; Molding Sands; The British Industrial Fatigue Research Board; Medical Fellowships of the National Research Council; International Chemical Conference at Utrecht..... 365

Scientific Notes and News..... 370

University and Educational Notes..... 372

Discussion and Correspondence:

Genetical Analysis and the Theory of Natural Selection: DR. W. BATESON. *A Suggestion to Mr. Bryan:* DR. EDWARD M. KINDLE. *The Writing of Popular Science:* DR. N. E. DORSEY..... 373

Quotations:

The Earning Power of Research..... 376

Scientific Books:

Clark's Monograph of the Existing Crinoids: DR. W. K. FISHER..... 376

Special Articles:

A New Variety of Barley with Striking Characteristics: DR. KWEN S. HOE..... 378

The Annual Meeting of the Federation of American Societies for Experimental Biology: PROFESSOR CHARLES W. GREENE..... 379

THE EARLY TRAINING OF SCIENTISTS

IT is a strange feature of the modern educational process that though children are born richly endowed with scientific instincts into a world which has gladly accepted a multitude of gifts from science, they encounter, from the cradle to the university, constant opposition to the education of these instincts.

The child is excellent raw-material for the making of the scientist. First of all, he is curiosity incarnate; he does not confine his attentions to those matters which adults consider practical, but tries to learn all he can about an environment which he finds brimming with interest. Moreover, he is an experimentalist, and the days are too short for the experiments he wishes to perform upon everything at hand, from the bric-a-bric to the patience of his elders. He relies upon experiment rather than upon authority for learning truth. Authoritative representations concerning the fragile qualities of glass, the taste of pepper or the temperature of a stove are to him but suggestions for experiments. Although his experimental technique is simple and his capacity for reasoning and theorizing are undeveloped, he has made a splendid beginning towards a scientific career.

In his further development, however, he meets with opposition at every turn. Many of his experiments earn punishment from his parents, who discourage his curiosity and even pervert the truth for their own ends. At school, book-learning is substituted for observation and experiment, and even when the topic is nature or science it is often taught in a very didactic way by a teacher who, though having taken many courses in pedagogy, may have but little appreciation of the spirit and method of science. At Sunday school he is likely to find a teacher who praises as religious virtue the

docile acceptance of dogmatic authority and to whom the term "doubt" is one of opprobium.

The repressive process, alas, does not end here, for we in the university who next take him in hand delight in giving him the impression that the subject has been thoroughly elucidated. We take little pains to help him to realize the existence of vast fields awaiting exploration. Moreover, we are so anxious to guard him from errors of fact that we announce in advance what he is expected to find in his experiments. He is told to mix solution A with solution B and "to note the red precipitate which is formed." The precipitate he gets may happen to be yellow, but he has learned by this time that it is safer to call it red in his note-book. Why quarrel with the instructor, it is wiser to give the answer he wants and keep him in a good humor.

I am convinced of the justice of the foregoing diatribe, as I have had an intimate acquaintance with the problem, not only as a child, a student and a parent, but, I must confess also, as a teacher. Indeed, so thoroughly convinced have we been in the department of chemistry of the University of California of the importance of giving the student, so far as we can, a real training in the scientific method and spirit, that we have taken great liberties with that most conservative of all university courses, the freshman course in general chemistry. So many have asked for information concerning our methods that I am encouraged to assume sufficient general interest to justify an exposition of our attempt at the solution of this important problem.

We have been inspired by the opportunity offered by a fundamental course to present science in such a way as, first, to win for scientific careers the keen-minded students who are repelled by the drudgery and memory work of the old-fashioned course in descriptive chemistry; and, second, to encourage the average student to adopt the scientific attitude towards his everyday problems, an attitude so necessary in combatting the superstition, prejudice, selfishness and dishonesty in the world of ordinary affairs.

Although the following paragraphs describe a course in chemistry, our aim in giving this course is not simply to teach chemistry, but through it to teach science. Whether the student proceeds to advanced work in chemistry or enters one of the numerous fields for which it is prerequisite, or even takes no further scientific studies, it is important for him to have scientific training. The medium for this training is with us chemistry, but other subjects can, of course, be taught with a similar purpose in view.

In order to attain these ends we have been convinced that the laboratory work must be the central feature of the course, and that it must involve the solution of problems rather than the mere performance of illustrative experiments. This makes the work harder and therefore more interesting. The doctrine that the interest of the pupil is to be gained through ease and practicality is an educational fallacy. The student belies this doctrine in his own practice. Football is difficult and impractical, but it arouses far more interest than dishwashing, which is both easy and practical.

The teaching of elementary chemistry has been slow to reflect the modern state of the science, which is no longer chiefly descriptive, but to a high degree mathematical and deductive. It has largely continued, in the language of Le Chatelier, to present "une énumération indéfine de petits faits particuliers: Formules de combinaisons, densités, couleurs, action de tel on tel corps, recette de preparation, etc." Laws and principles appear to the student as dykes intruding into the mass, but not fusing with it. While it is difficult and probably undesirable to abandon altogether the traditional method, we have sought to substitute for much of the purely informational material, a grasp of great principles such as the atomic, molecular, kinetic and ionic theories, the mass law, and the periodic system of the elements, and to make them not mere definitions, but tools to be used with intelligence and skill. It is of little use for the student to define the mass law unless he can actually use it in controlling a new chemical reaction. There is little point in committing the periodic table to memory unless he can apply it with assurance in predicting chemical behaviors.

We have been fortunate in being able to in-

clude general chemistry and qualitative analysis in one intensive course of two laboratory periods, two quiz periods, and two lectures per week throughout the year. It has thus been possible to minimize the usual break between these subjects and to develop systematically from the general principles of chemistry to their application in the problems of analysis. In the laboratory manual, written by Professor W. C. Bray with the assistance of Dr. W. M. Latimer, the effort has been to stimulate the student, through proper experiments; first, to gain a working conception of the atomic theory, the molecular theory and the behavior of gases. There follows next, a study of acids and bases and of titration, in order to develop and apply the idea of concentration. A further study of acids, bases and salts leads to the ionic theory. In this connection we have not considered it necessary to discuss an element at length before studying one of its compounds. Acetic acid, for example, is a quite familiar substance, whose acid properties may be investigated before studying organic chemistry, and it is not necessary to discuss sulfur, sulfur dioxide and the manufacture of sulfuric acid in order to do some laboratory work with the acid. There follow assignments on strong and weak acids and bases and the uses of indicators to measure the concentration of hydrogen ion; rapid reversible reactions and equilibrium; the reversibility of neutralization reactions, or hydrolysis; the properties of sodium, potassium and ammonium ions and the tests for sulfate and nitrate ions; the chemistry of calcium ion, developing solubility equilibria and the transformation and solution of precipitates; carbonic acid, carbonate and bicarbonate ions; the salts of copper, sulfur and zinc, which prepare the way for the study of complex ions, amphoteric hydroxides and the important reactions utilized in qualitative analysis.

Unknown solutions of increasing difficulty are introduced during this period, but more emphasis is placed upon the student devising methods of analysis than upon committing to memory and using the orthodox schemes, which few chemists ever use in actual practice without appropriate short-cut modifications. Oxidation and reduction reactions and electric cells are next introduced, followed by a study of ions whose separations involve oxidation and reduction.

The effort is made constantly to throw the student upon his own responsibility, especially in observing accurately and in drawing general conclusions from his experiments. There are numerous questions calling upon him to predict results of untried experiments.

The lecture work is organized to supplement closely the laboratory work and to contribute an element of stimulus and inspiration. The topics in the early part of the course are taken up in much the same order. When acids, bases and salts are introduced in the laboratory, the lectures take up the alkali metals followed by the alkaline earth metals. The chemistry of the metals is so much simpler than that of the non-metals that we have been more than satisfied by our abandonment of the usual order of presentation in which the halogens are introduced early in the course. An intensive study of the periodic system and its use in predicting and correlating not only physical properties but chemical characteristics as well, continues throughout the year with necessary interruptions from time to time by other topics.

A reference book has been written for the course in which the aim has been to present clearly and briefly the principles of chemistry. The topics have been arranged in convenient order for reference rather than as in the lectures. The program of the lectures can thus readily be altered from year to year to try experiments of instruction, and making it easier to avoid the stagnation so fatal to even the best of courses.

But though general principles are emphasized in the teaching, we feel that the final test should not be the statement of the theories but their application. In our examinations, therefore, we usually say little about theories and principles, asking the student rather now to prepare one salt from another; how to accelerate or retard given reactions; how to shift certain equilibria; how to dissolve various precipitates; whether he would expect a given acid to be

stronger or weaker than another, or a certain salt to be more hydrolyzed than another; what properties of substances make them useful for certain purposes.

The success with which the more intelligent students are able to answer such questions has convinced us of the efficacy of this form of instruction. The students seem also to grasp something of the enthusiasm and interest in the science of chemistry which turns some of them ultimately into capable research workers. We have noted with considerable satisfaction moreover, that even the more purely descriptive type of chemistry is rather readily learned. It is evident that the habit of correlating facts with each other and with theory has made the assimilation of the information comparatively easy.

In order to achieve its object such a course must have the advantage of contact with the more advanced work and the research carried on in the department, and must be taught by men interested in discovery. It has been our policy, therefore, for all members of the departmental staff to take part at more less frequent intervals not only in the weekly conferences of instructors, but also in the laboratory and quiz sections. This practice has been effective in unifying the purposes of all the departmental courses. The junior assistants are all candidates for the Ph. D. degree, and hence actively engaged in research. The better students are frequently invited to see the work these graduate assistants are carrying on in the research laboratory, which proves a source of considerable inspiration.

Thus beginning with students from the high school, many of whom have not had even high school chemistry (for we admit students if they have had high school physics and trigonometry), we are able to accomplish in a single intensive course what is ordinarily extended over two years; and by continuing the same intensive method in the more advanced courses, to prepare the student for serious research at the beginning of the senior year. The large proportion of students who go on into graduate work and the output of the laboratory in research are evidence of the rich fruit of the method. We are confident also that those students who have studied elementary chemistry as preparation for some allied science have received a far better training for their later work than a more purely informational course could afford.

Joel H. Hildebrand

ARE IODIDES FOODS?

It has been considered by some biologists and chemists that living matter originated in the sea and the elements of living matter correspond to those found in the sea water. We might look, therefore, to the composition of sea water for the elements we should expect to find in living matter. Sea water consists largely of H_2O and sodium chloride, and besides those the chief ingredients are magnesium, calcium, potassium and carbonates, sulphates and bromides, but there are also present the following elements in traces: ammonia, lithium, rubidium, cæsium, strontium, barium, manganese, zinc, iron, cobalt, nickel, lead, copper, silver, gold, radium, fluorine, iodine, nitrate, phosphate, silicate, aluminium, boron and arsenic. In searching for these substances in living tissue they have been found chiefly in marine organisms. However, chemists are finding them to a greater and greater extent in tissues of mammals. Damiens[1] finds bromine in a large number of animals and Gautier[2] finds iodine in quite a number of animals. We are familiar with the fact that fluorine is a regular constituent of bones and teeth and iodine of the thyroid gland. In experiments on the nutrition of animals, I have found it very convenient to feed them evaporated sea water and in this way insure a supply of all the rare elements. Cameron and Carmichael[3] have not observed any deleterious effect in feeding rather large doses of sodium iodide to white rats and rabbits. The use of sodium

[1] Damiens, A., *Comptes Rendus*, 1920, clvvi: 930. Damiens, A., *Bull. Soc. Chem. Biol.*, 1921, iii: 95.

[2] Gautier, A., *Comptes Rendus*, 1920, clxx: 261; 1899, cxxix: 66.

[3] Cameron and Carmichael, J., *Journal of Biological Chemistry*, 1920, xlv: 69.

iodide in preventing goiter in sheep and in preventing the hairless pig malady is quite well known. The use of iodide in the treatment of goiter was first brought out by the work of Dumas, who was born in 1800 and studied pharmacy in Geneva. Dumas and Coindet found that iodine was valuable in the treatment of goiter. The use of sodium iodide in the prevention and cure of goiter was strikingly emphasized in 1917 by Marine and Kimball.[4] This leads to the natural conclusion that the cause of goiter, or at least one of the causes, might be the lack of iodine in our diet. Iodine seems to be very rare in food and soils (Private communication of Oswald Schreiner) or else the former methods of detection have not been sufficient for such traces as do exist (See Kendall and Richardson[5] for later methods). Iodine has been found in a number of rocks such as slates (Gentile[6]), limestones (Lembert[7]), dolomite (Rivier and Fellenberg[8]) and granites (Gautier) in Europe and has been reported in vapor from Vesuvius (Matteucci[9]), but it seems to be leached out so rapidly from soils it is seldom to be detected. Forbes[10] failed to find iodine in about half of the specimens of foods, and Cameron[11] had a similar experience. The question of the relation of goiter to locality has caused much discussion and most persons have come to the conclusion that goiter is due to the presence of some substance rather than the absence, but since much fruitless work has been done in the attempt to find this substance it would be well to investigate more thoroughly the question of the absence of some substance.

[4] Marine, D., and Kimball, O. P., *Jour. of Lab. and Clinical Med.*, 1917, iii: 40.

[5] Kendall, E. C., and Richardson, F. S., *Journal of Biological Chemistry*, 1921, xliii: 161.

[6] Gentile, 1849, *Jahresber. d. Chemie*, 251.

[7] Lembert, 1851, *Jahresber. d. Chemie*, 319; *Jl. Pharm.* (3), xiv, 240.

[8] Rivier and Fellenberg, 1853, *Jahresber. d. Chemie*, 924.

[9] Matteucci, 1899, *Comptes Rendus*, cxxix, 65.

[10] Forbes, E. B., *Bull. Ohio Agri. Station*, No. 299, page 487.

[11] Cameron, A. T., *Journal of Biological Chemistry*, xviii: 335.

Goiter occurs largely in mountainous regions or regions far from the sea. Iodine is so rapidly leached out of the soil that the supply of it may depend upon salt spray blown from the sea. During storms the waves are broken into a spray and the water evaporated and the salt carried for long distances through the air. This salt is washed down out of the air by rains and contaminates the rain water. In the accompanying figure 1 taken from Emmons[12]

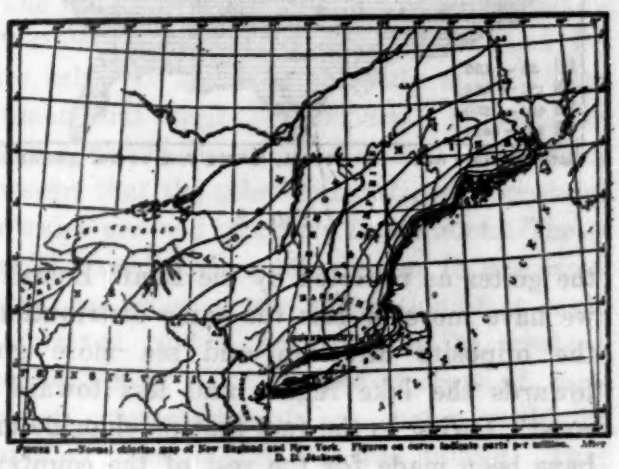

FIG. 1

is shown a map of the eastern states, indicating the relative amount of sea salt in the rain water. Determinations were made by the weight of a certain constituent (the chlorine ion) by the ordinary silver nitrate titration, but sea water is of very uniform composition in regard to everything except H_2O. That is to say, when the salts are diluted or concentrated, they are all changed in the same ratio, and the dry salt would be of uniform composition, so that the chlorine titration would indicate the relative amount of iodine. Evaporated sea water contains 50 parts per million of iodine, whereas the chlorine forms 55 per cent. of the evaporated sea water. The lines on the map indicate parts per million of chlorine in the rain water and the iodine would be about one ten-thousandth of this amount, or, in other words, a part per million of chlorine would be about a part per ten billion of iodine. We can say, therefore, that the amount of iodine in the rain water rapidly decreases as we go from the coast, and is least

[12] Emmons, W. H., 1913, *U. S. Geol. Survey Bull.*, 529.

in the Great Lakes region. Figure 2 (taken from Davenport and Love[13]) shows a map of

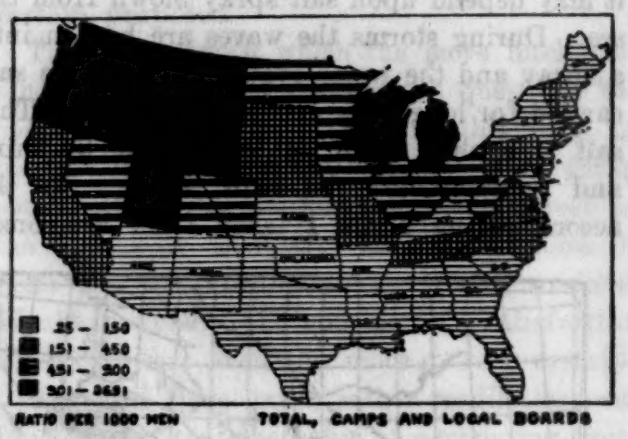

FIG. 2

the goiter as reported by the Draft Board and we have more or less the same distribution in the opposite direction and see more goiter towards the lake region and less toward the coast. Owing to the fact that no chlorine maps have been made for the rest of the country, it is not possible to extend this comparison. It is reported, however, from various sources (and is my personal observation in Minnesota) that the whole Great Lakes region is quite goiterous, and this is necessarily a region in which very little sea salt falls upon the land since the air blowing over it has already been washed free from sea salt by previous rains. Besides this goiterous region, various mountainous regions in the country have been reported to be goiterous and this is also true of Europe. These mountainous regions may be relatively near or far in relation to the sea. We often speak, however, of the clear mountain air free from dust, and it seems very probable that sea salt, being very heavy, would tend to remain in the lower strata of air rather than rise to mountain heights. Volcanic dust when thrown to great heights may remain in the upper air for a considerable time, but this is true only of the very finer particles of dust. The larger particles settle very rapidly. In fact, so rapidly as to sometimes bury towns. We may suppose the same things are true of the sea salt in the air. The very finest particles may be carried to greater heights than the larger ones, provided they can escape the rain long enough to reach that height in the first place. The volcanic dust is thrown rapidly to the great height. The sea salt is thrown into the air at the sea level and its reaching a great height is very fortuitous. Therefore, we may suppose that the occurrence of goiter in mountainous regions fits in with the deficiency hypothesis. The absence of iodine from the rain water and soil in a region would necessitate its absence from the plants growing in the region and the animals subsisting entirely upon the plants and rain water. Man, however, may receive considerable food from some distance. Food rich in iodine, such as fish, oysters, squid, sea-hares, sea urchin ovaries and sea weed, is consumed to a much greater extent along the sea coast than in inland regions. Sea weed is not a general article of diet and is only eaten habitually by the Japanese and certain other peoples living close to the sea. Sea food, owing to its perishable nature, is largely consumed close to the sea. Therefore, even with considerable means of food distribution, the relation of goiter to distance from the sea might still be maintained. Water might hold the same relations. Water flows toward the sea and therefore does not bring iodine from regions richer in it. Water courses rise either in mountainous regions or in inland lakes which are goiterous regions. Certain mineral springs may be exceptions but the consumption of such mineral water is rather limited.

The principal other factor in the diet is salt. Salt was first obtained by the evaporation of sea water. The process used reduces the amount of iodine, but the extent of reduction may depend upon the amount of refining that the salt undergoes. The sea water is evaporated in shallow ponds until the calcium carbonate precipitates. It is then further evaporated in other ponds until the sodium chloride crystallizes out. The mother liquor from the sodium chloride crystals, known by geologists as the bittern, contains most of the iodine along with magnesium chloride and other salts. This crude sodium chloride, which may have some iodine clinging to it, was formerly con-

[13] Davenport, C. B., and Love, A. G., 1920. *Scientific Monthly.*

sumed in this condition but nowadays is often further purified by washing and recrystallization so that the iodine, which is in very low concentration in the sea water, is reduced to infinitesimal quantities. Salt was not purified to as great an extent in the early days as it is now. When it comes to rock salt Nature has already purified it to some extent. Van't Hoff showed the mechanism of stratification of the rock salt deposits. The sodium chloride layers are already more or less purified. This salt when it is mined in the dry state or when it is obtained from salt springs, which consist of water which has come in contact with these salt deposits, is still further purified for table use. Hayhurst[14] investigated some of the salt works in Ohio where the salt is obtained from deep wells. Bromine and a trace of iodine are separated out of the salt and the bromine sold as a by-product.

I have been unable to obtain any evaporated sea water, that is to say, salts obtained from the sea water without fractional precipitation or purification, from any commercial salt manufacturers on the coast. Through the kindness of Metz & Company, Dr. Sherndahl evaporated 100 gallons of sea water for me to use in experimental feeding. This, together with sea water which I have had opportunity to evaporate, has been dried by baking it in an oven. When the last traces of water are eliminated in this way, hydrochloric acid fumes are also given off. The cause of this, as pointed out by Sorensen, is a reaction between magnesium and the other salts whereby oxides of the alkaline earth metals are formed with the elimination of hydrochloric acid. If the baking is continued long enough no calcium or magnesium chloride remains and therefore the salt remains dry. If the sea water has been evaporated in an iron kettle some iron oxide is added to it, which improves it from a nutritive standpoint. The necessity of baking may be eliminated by adding 6 grams of H_3PO_4 to the liter and this salt may aid in the treatment of rickets. In my animal experiments this evaporated sea water has been used for generations of animals as the salt ration, with gratifying results. It is very low in phosphoric acid unless H_3PO_4 has been added, and if casein is used as the protein there is not sufficient phosphoric acid in the casein for the nutritional requirements. The question as to whether there is sufficient calcium or not for the total calcium ration has not been definitely settled. If wheat flour is used for the carbohydrate portion of the ration there is sufficient additional calcium in the wheat flour to bring the calcium up to the requirements.

The question arises whether it would not be advisable for us to feed our children an impure salt. If iodine is the only mineral constituent that might be deficient it could be easily added to the salt. We have not proved, however, that the other mineral constituents of sea water are not necessary in the diet. Therefore, it would seem much simpler to use evaporated sea water as the salt ration if it could be obtained, and it only remains to create a demand for it. The present process of commercial evaporation of sea water could be simplified if an impure salt was desired. That is to say, only one pond would be necessary for the evaporation of the sea water. Sea water could be evaporated in this pond as far as practical by the sun. The total contents of this pond, including both solids and liquids, could then be removed and evaporated by heat and thoroughly mixed, and baked at a high enough temperature to produce a dry salt. In case the crystals of salt were large, owing to the slow evaporation at first, they could be ground. In baking, however, there is a tendency for these crystals to break up. The inclusion of a little earth with the salt would not impair its nutritive qualities and the product would be sterilized by the high temperature used in baking. It has been shown that salt obtained by the usual methods from the salt evaporating plants on the French coast is reeking with bacteria. The production of a sterile product might be an advantage. The dietary salt of several adults, children and infants has been limited to the above described from Metz for many months with gratifying results, in a goiterous region.

J. F. McCLENDON
THE LABORATORY OF
PHYSIOLOGICAL CHEMISTRY,
UNIVERSITY OF MINNESOTA

[14] Hayhurst, E. R., SCIENCE, 1921, liv: 131.

GEOGRAPHY AS A PROFESSION

INTRODUCTION

MODERN geography is a young science, and usually college students know little of its content. If they think of it at all, it is usually as a subject which they were forced to study when young, but sloughed off when they became men. They do not recognize that the causal element now stressed so strongly has given it a content which has placed geography in the university curriculum and added greatly to its practical worth.

RELATION TO OTHER SCIENCES

The first point to appreciate is that a liking for geology, physics, biology, mathematics, astronomy, history, economics, anthropology, or ethnology, excludes no one from becoming a geographer. Geography is not an isolated science. It is an intensively interlocking combination of other sciences directed towards a broad, but specific field of study. The great war, if it has proven anything, has proven that geography and its ramifications present problems worthy of the keenest and best trained intellects of the day. The fact that geography is now understood to be of value in settling disputes between new states, in understanding the possibilities of commerce open to this nation's newly created merchant marine, and in interpreting to the advantage of all concerned the prides, prejudices, and virtues of those with whom foreign trade does or may bring close contact, has added greatly to the prestige of the science and those professing it.

OPPORTUNITIES IN GEOGRAPHY

Several types of employment are open to the geographer. The following list is not exhaustive, but suggests the major opportunities offered.

1. The government now recognizes as never before the value of trained geographers. There can be little doubt but that its need of such men will increase.

2. Map-publishing houses must employ skilled geographers.

3. Great corporations, commission houses, and banks, as the United States expands its foreign trade, are recognizing more and more the necessity of having trained geographers on their staffs. Certain banks have found it necessary to establish their own schools in order to give adequate geographic training to men in whose charge they wish to place their foreign branches.

4. Although the world is commonly thought of as pretty well explored, the facts are that many large areas even on our own continent are known only very superficially. Skilled geographers are needed to accompany scientific exploring expeditions, and with the increasing need of tropical products, the demand for such men will increase.

5. Men can not take advantage of the preceding opportunities without adequate training. At this present moment, universities are handicapped in giving this because of the lack of trained teachers. The supply by no means meets the demand. The student who prepares himself to teach university geography is taking advantage of one of the best opportunities in the entire pedagogical field and rapid promotion is certain for him if he deserves it.

TYPES OF INVESTIGATION POSSIBLE

The main types of investigation possible are as numerous as are the sciences allied to geography, with almost innumerable subordinate lines under each. A study of the table of contents of a half dozen leading geographical journals at home and abroad will give some idea of their variety. Within their covers will be found studies of all phases of weather and climate, of the physics of the atmosphere, of map-making and map-interpretation; explanations of the distribution of the races and languages of man, and of the relations between man and his natural surroundings; discussion of why some countries are great and others weak; accounts of exploration; reasons for the courses and materials of trade; and the whys and wherefores of the surface of the land and the bottom of the sea. This is just a hint of the variety of interesting, instructive, and profitable studies which come to the geographer.

COMPENSATION

Few geographers will become rich. The desire for wealth can never be the compelling

reason for entering this subject any more than others. There are, however, varied reasons why a young man may well consider it as a life pursuit.

1. Vigor of body is the natural reward of the active geographer. This needs no amplification.

2. The geographer is brought into intimate contact with many lines of human interest and endeavor. Soils, crops, commerce, landscapes, weather, all kinds of natural resources, both developed and potential, interest him. And, if he travels, as he must to progress far in his science, he gains an insight into the hearts of men and nations second to none. The geographer becomes in reality a "citizen of the world" with much power to promote international understanding and good-will.

3. The modern science is young—younger even than its sister science, geology. Two important results follow:

(*a*) The opportunities for employment are numerous. Those who enter the subject now are on the "ground floor" as it were, in a movement which promises to be of much educational and economic importance.

(*b*) The opportunities for original discoveries and contributions are great. With their accomplishment comes the reward which the consciousness of having added to human knowledge always brings. The full power of this needs to be experienced to be understood. There is also the additional satisfaction which comes from being a pioneer in the development of new aspects of an important subject.

These advantages are on the whole quite similar to those of geology. In this connection, it may be interesting to know that while numerous men enter geology from other subjects, few leave it—and of those who do, by far the larger number change into this closely allied science, geography. The application of the broad learning of many years to a study which opens unlimited possibilities for bringing to mankind material prosperity, mutual good-will and friendly understanding, is intensely fascinating to the maturing man who feels a call to serve humanity, yet desires to labor and investigate in his chosen fields of science. Any young man who has seriously thought of scientific work as an attractive life profession must find in geography an appeal which merits his careful consideration.

H. P. LITTLE
NATIONAL RESEARCH COUNCIL

VIENNA

WHILE in Vienna last summer I was like other visitors deeply impressed with the supreme importance to the world of the problem of relieving this sadly stricken capital. At that time the exchange rate for the Austrian crown was about 600 to the dollar and it has since fallen to a rate of 10,000 to the dollar. The average salary of the professional man even six months ago was only the equivalent of between $100 and $200 a year, and the recent financial panic has brought the intellectual worker to straits which are almost beyond belief.

There are, it seems to me, three reasons why the situation in Vienna makes a unique appeal to the professional men and women of America. In the first place the actual suffering is far greater in Austria than in any other country outside of Russia. In the second place, there is at stake here not only the life and health of individuals but the life of a civilization, one of the most liberal and enlightened in the world. The universities and schools of Vienna have for centuries been the eastern outposts of the intellectual life of western Europe and in music, in medicine, and in many other arts and sciences her contribution has been unrivalled. In the third place, a peculiar responsibility rests upon America in this connection because the recent panic would have been entirely prevented if the congress of the United States had not delayed for six months the passage of the foreign debt funding bill which was essential to the carrying out of the Ter Meulen plan for the financial rehabilitation of Austria.

We can take great pride in what has been done by the American Relief Administration, the American Red Cross and the Friends Relief Mission to mitigate the suffering of the people of Vienna. With the passage of time, however, it is natural that the enthusiasm of

service should somewhat relax. It is important to remember that the situation is if anything to-day more critical than ever, and that the year 1922 will probably determine whether Vienna shall survive or perish as a center of intellectual and artistic life. I am therefore venturing to ask if you will not print the enclosed extracts from a letter just received from Miss Hilda Clark of the Friends Relief Mission, who has just returned to Vienna after a visit to the United States. I have personally no connection with the Friends Service Committee but I admired the work they were doing in Vienna beyond measure and I can assure the readers of SCIENCE that gifts of money or of clothing sent to the American Friends Service Committee, 20 South 12th Street, Philadelphia, for the use of the professional men and women of Vienna will accomplish a service of unique value for humanity and civilization.

C.-E. A. WINSLOW

YALE UNIVERSITY,
FEBRUARY 3, 1922

EXTRACTS FROM MISS CLARK'S LETTER

I am interested to find, on getting back here, that the worst effects of the financial collapse of last autumn have not yet begun to show, at any rate, among the majority of the working-class population. Unfortunately, the reason for this is one which no one dares to think can be more than temporary. It is, that wages have boldly been put up, and in many trades, have almost risen to follow the increased cost of living so that people are actually better off than they were two years ago.

This applies particularly to food. The situation in regard to clothing is rather curious. Even in those trades where the rise in wages has been greatest, the fluctuation in prices is so uncertain that any article of clothing, for which it is necessary to save from week to week, is likely by the time the necessary money to buy it has been saved, to have doubled in price. You will see what a strong discouragement this is to people to save, and how impossible they feel it. Really, the home maker is in much the same difficulty as the manufacturer, and the working man or woman has not always the intelligence to cope with it. This tends to make people, especially, of course, the more thoughtless, even if earning the best wages, spend their money on food each week, rather than save it for clothing. I do not think anybody would quite understand and sympathize with them who has not been, to some extent, in the same position.

Fortunately, the expenditure on food does, after all, help to restore the physique of the workmen, which had got so very much undermined before this rise in wages took place, but it creates a great deal of misapprehension on the part of social observers in the town whose first idea is that the working people are much better off than they really are.

This would not matter, were it not that there appears to be no hope at all that the present wage level can be maintained without causing a great increase in unemployment. It is not thought that industry can stand the present cost of production, as Austria has only obtained her markets, during the past year, by being able to undercut other manufacturers. It seems inevitable that she will go through the same phase of unemployment as has occurred in other countries. To meet this, she has at present absolutely no resources except a very uncertain amount of savings made by the most successful of the war-profiteers.

Perhaps one should add to her assets the extraordinary courage and grit a great proportion of the people are showing, and the energy with which they are turning to the increase of their home food production. Unfortunately, a good deal of capital is required to carry this out to a sufficient extent to enable her to tide over an industrial crisis, but the amount of capital needed is very much lessened by the energy and hard work which the men themselves are giving.

First of all, they have increased the allotment garden production, and having nearly all the land that can possibly be reached by the people living in the present houses in Vienna, they are moving out to live in the country close to, and building houses with their own hands to live in while they cultivate the land. In this way, their labor is not withdrawn from the industries which are still working, and if there is temporary unemployment, they will be ready to return when conditions improve.

I think it is important that people should realize that to provide capital for this increase of the home food production is the only way of averting absolute starvation if unemployment on a large scale should occur, even if this were only temporary. There is no reason to suppose that industry here could not recover directly condi-

tions in Europe generally improve, or that Vienna would not be able to take her place on equal terms with other countries without the advantage of a cost of production subsidized by foreign relief.

With regard to the actual physical condition of the people at the moment, especially of the children, in which the people who have so generously helped in America are naturally most interested, thanks to this increase in wages, which has kept the majority of the working class from coming on our hands for relief, we have been able, with our limited programme, to do what was necessary to save the lives of the children, so far, this winter.

In the middle-class, where rises in salary, and fixed incomes have not come anywhere near the increase in the cost of living, the suffering is very terrible, and increasing as the colder weather sets in; we are now in the grip of a snowstorm which makes life almost impossible for people who have not been able to buy either clothing or fuel, and whose food has been reduced to about a quarter of that needed to maintain their vitality. The professional classes here have few children, and have had hardly any since the war, so that the relief for young children, which is our main piece of work, does not very much help them.

We have, therefore, turned our attention very specially to them this winter, and are particularly increasing, as far as our funds will allow, the help for the young children between the ages of 14 and 18 who, even if given one meal a day by the American Relief Administration, and only a very few of them get this now that the numbers have been reduced, are really not able to keep body and soul together while they are training themselves to earn their living.

The students in the university are still getting some help from the World's Student Christian Federation, but this, unfortunately, is coming to an end, and it is terrible to think what will happen, if they are unable to continue it, as the position of the students is certainly worse than it has ever been.

We are specially turning our attention to the lower grade or trade colleges of a lower standing than the university, and which are not included in this student relief,—where a great many of the poorest of the professional classes are trying to get their boys and girls trained for work which will enable them to earn their living more quickly than they could if they had to take the whole university course. We are now helping nearly 500 in this way, providing a fortnightly ration of extra food, enough to give about a third of the minimum calory requirements for an adult, and are also dealing with the whole family, who are often found, after individual investigation, to be in the most pitiable plight. All these families have had a ration of clothing averaging from six to ten garments per person, towards which they pay a trifling sum, which covers overhead expenses, and other help has been given where it was felt that the family could be placed in an independent position.

The students selected for help have been generally those in their final year, as it is found that this is the time when they tend to break down from the strain of combining study and a job, in the attempt to earn their keep. We are hoping to double the number, but if only we could obtain the funds we ought to increase it to 2,000 or 3,000.

At present, the need for clothing is, perhaps, the most pressing general requirement. We do not, of course, need to raise funds for those in receipt of the best wages, even though they are in the difficulty I described in the beginning of my letter, but it must be remembered that the great majority are still only in receipt of wages that will barely provide the minimum food for a family, and have absolutely nothing to spend on clothing, and in the professional classes, this is universally the case. They are faced with losing their jobs because they have not got the clothes in which to stand, and the bitter weather now upon us is, of course, making the need tenfold more urgent.

People may feel that it is now too late to send clothing for this winter, but if you are able to make it known how great the need is, I hope you will not let people be discouraged by the idea that it may be too late, because people require clothes to wear in the summer, and particularly in the case of underclothing, we did not find last year, that the demand was greatly lessened at the end of the winter.

SCIENTIFIC EVENTS

MEXICAN ARCHEOLOGY[1]

AT a meeting of the Royal Anthropological Institute on November 22, Mrs. Zelia Nuttall gave an account of recent archeologocal investigations in Mexico. As an introduction to her report, Mrs. Nuttall referred briefly to the fact

[1] From *Nature*.

that after a period of quiescence of some centuries the great volcano Popocatapetl had again become active in 1920, and that its activity still continued.

During the last decade evidence that great volcanic disturbances had taken place at long intervals has been forthcoming. Two distinct types of figurines have been found in conditions which indicate that the topography of the valley has been changed and its inhabitants destroyed by great catastrophes antedating the arrival of the Nahuas or Aztecs.

Of these figurines the first, provisionally distinguished as the sub-gravel type, was brought to Mrs. Nuttall's notice in 1920, when specimens were offered for sale by Indians, and she herself discovered an example *in situ* under a gravel bed at Atzacapotzalco. They were delicately fashioned of fine clay, with slender bodies, long faces, smooth-hanging hair, some wearing chaplets. All presented a worn and polished surface. In the Valley of Mexico the gravel beds extend under the lava flow at the base of the extinct volcano Ausco.

Under the lava bed, to which Dr. Tempest Anderson assigns an age of at least 20,000 years, Mrs. Nuttall in 1908, and afterwards Senor Gamio, head of the Department of Archeology of Mexico, have discovered a second type of figurine, to which the name "sub-lava type" has been given. This type is characterised by turbans and caps, evidently of fine stuffs or fur, and decorated with circular ornaments of stone or shell. They indicate that the southern part of the valley was inhabited by a race totally distinct from that of the "sub-gravel type" and the Aztec. The distribution of the clay figurines is now under investigation. They have been traced as far as Guatemala.

Mrs. Nuttall also described the results of recent excavations at Teotihuacan, during which a small pyramid was opened up and reconstructed by Senor Gamio. A tunnel pierced at the height of 35 feet to the center of the pyramid revealed that it had been formed of mud filled with innumerable fragments of pottery vessels which had prevented the mud from cracking when it baked in the sun. A remarkable discovery was that of the remains of the ancient pyramid temple with a wonderful sculptured frieze which had been partly destroyed and then concealed by another terraced pyramid temple built in front. The sculptured serpents' heads and the masks of the water-god Tlaloc are of a form hitherto unknown. Associated with them are sculptured shells, principally the conch shell and the pecten or pearl shell. Not only is it remarkable that sea-shells should be represented in sculpture in the heart of the continent, but the association of the water-god with the ocean is entirely new.

In the discussion which followed Mrs. Nuttall's paper, Mr. Maudslay expressed the hope that it might be possible before long, by the elaboration of a system of stratification, to date Mexican antiquities. As Mexico appeared to have been untouched by outside influence, the study of its antiquities afforded evidence of the highest value for the study of the development of the human mind acting by itself. Mr. T. A. Joyce emphasized the importance of the evidence relating to the figurines, and pointed out that the British Museum had acquired a figurine of similar technique from Ecuador. Professor Eliot Smith expressed the opinion that, contrary to what had been stated by Mr. Maudslay, Mexican antiquities showed clear evidence of influence from outside and in particular from Asia. Mrs. Nuttall's work showed that this culture must have crossed the Pacific.

THE ROYAL AGRICULTURAL SOCIETY OF ENGLAND

The council of the Royal Agricultural Society of England has, as reported in the London *Times*, unanimously adopted a report from the chemical committee of the society, which had been instructed "to consider in what way, in view of the altered circumstances, the scientific side of the society might be developed." The council afterwards appointed the following research committee to carry out the research proposals made by the chemical committee:

The Duke of Devonshire, Lord Bledisloe, Professor W. Somerville, D.Sc. (Oxford), Mr. Dampier Whetham, F.R.S. (Cambridge), Mr. Henry Overman, and Mr. John Evens, with Mr. Charles Adeane (chairman of the finance

committee), Mr. J. L. Luddington (chairman of the chemical committee) and Mr. C. Coltman-Rogers (chairman of the botanical committee) as *ex officio* members.

The chemical committee recommended that the society should form a fund definitely reserved for research, into which payments should be made as funds allow. The following paragraphs summarize their proposals:

(*a*) That the results of the past experimental work of the society should be collated, abstracted and published.

(*b*) That the society should continue to devote part of its scientific energies to agricultural research, and should at once establish a separate fund for its support.

(*c*) That members of the society be invited to make suggestions as regards practical problems which they consider require experimental investigation.

(*d*) That members of the society be invited to cooperate, by the provision of land, stock, etc., in carrying out such work.

(*e*) That scientific institutions as occasion arises be asked to aid the society in the elucidation of problems that can not be dealt with on an ordinary farm.

(*f*) That a research committee of eight members be set up, to review proposals and to initiate and supervise experiments.

(*g*) That the research committee should submit to the council in November estimates for the forthcoming year's work, and in March a report on, and the audited accounts for, the work of the last year.

(*h*) That arrangement be made at once for the publication of past experimental results, and that experiments be initiated as soon as possible.

The committee points out that the society has successfully undertaken a large amount of valuable and varied experimental work, not only at Woburn, but elsewhere, and results of much service to agriculture have thereby been secured. The work has included the manuring of crops and grass, green manuring, sowing down land to grass, the quality of seeds, finger and toe in turnips, the treatment of farmyard manure, cheese making, the fattening of cattle, sheep and pigs, and the rearing of calves. The results are reported in the *Journal,* but, although available, are not convenient of access. The committee believes that farmers and students would benefit greatly if the society would issue, in at least two volumes, one dealing with crops and the other with stock, the experimental results it has achieved. A substantial fee would have to be paid for the work, but there should be no difficulty in finding a firm who would relieve the society of any financial responsibility in respect of publication.

The committee holds that further experimental work is vital to the interests of the society. For "research without reference to utilitarian ends" the society is not fitted, either in respect to technical equipment or of personnel; but it is eminently quality to undertake research which deals directly with problems that arise in practice. Its members consist largely of practical farmers with long experience of the land and of the difficulties and problems of its cultivation.

At the moment the committee suggests that the following questions might well engage the society's attention:

(*a*) The value of ground mineral phosphates, more particularly in the improvement of pasture.

(*b*) The use of various forms of lime on grass and tillage crops.

(*c*) The use of wild white clover, wild red clover, bird's foot trefoil, etc., in laying land down to grass.

(*d*) The profitable utilization of whey.

MOLDING SANDS

THE Committee on Molding Sand Research under the guidance of Division of Engineering, National Research Council, and the American Foundrymen's Association, has made progress in its program of research. The United States Geological Survey and the various state geological surveys have promised to cooperate with the sub-committee dealing with this phase of the work under the chairmanship of Professor H. Ries, of Cornell University. This subcommittee has prepared a letter of instructions to the state geological surveys, which will standardize methods of making the surveys of molding sand resources.

Work on standardization of tests is well under way. Questionnaires have been sent out to gather information on the present methods of testing physical properties of sand. A

digest of replies to these questionnaires is expected to be available shortly.

Many firms and universities have offered to cooperate in the research work. Every endeavor will be made to maintain their interest and to assign problems to those universities and industrial laboratories offering to cooperate; due regard being given to the facilities and talent available. A list of research subjects has been compiled, which is given in part below:

1. Recovery of used molding sand through restoring bond to the sand by subjecting it to contact with water vapor under high pressure.

2. The effects of additions of certain chemical reagents upon the physical properties of clays and clayey materials, such as molding sand.

3. Effects of water content on the bond and permeability of a molding sand.

4. Effects of different water per cents. in molding sand on the milling and drilling speeds of light gray iron castings.

5. Research on fusion quality of facings (function of "peeler").

6. Tests of various kinds of clays for restoring bond to molding sand.

7. Comparison of the life of different molding sands.

8. Effects on plasticity of bond in molding sand and reduction of water content when using oil.

9. Effects of wet and dry storing of sand on bonding quality.

The American Steel Foundries Company has permitted a representative of the committee to make a digest of the sand reclamation work carried on by the engineering staff of the A. S. F. and has assisted in the preparation of this digest. Because of the scarcity of steel molding sand of the best quality and the problems arising from having to dispose of large quantities of refuse sand, this company has carried out an extensive investigation of methods of reclaiming the good material which is usually lost, whenever the so-called refuse sand is thrown away. After experimenting along different lines and thoroughly going over methods employed in other plants, a process of reclaiming old sand called "centrifugal scrubbing" was developed.

After establishing the principle of this method, equipment was designed which permits a recovery of about 70 per cent. of refuse sand. Cost figures for 1921 show that a ton of reclaimed sand costs about $1 per ton against the cost of new sand, at the plant, of $2.65 to $3.85 a ton. The process involves cleaning the sand grains of adhering fused material, then separating by air currents the good sand from the bad material. Included in the 30 per cent. loss is some good bonding material which, because of its similarity to bad material, can not be economically separated.

The report covers the theory of sand reclaiming, centrifugal air scrubbing process, cost of reclaiming sand by the latter process, and a description of the proposed sand reclaiming unit.

THE BRITISH INDUSTRIAL FATIGUE RESEARCH BOARD

THE second annual report of the Industrial Fatigue Research Board has recently been issued. As reported in the *British Medical Journal* it contains "a comprehensive summary of the chief results obtained by the board since its inception some three years ago. These results have been published in a series of sixteen reports, which represent the output of the board's investigators over a period of about two years, for there is necessarily a considerable delay before the results of the inquiries reach the stage when they are ready for publication. If any critic had doubts as to the value of the board's work, and the importance of its further development on the lines laid down in this report, we think that such doubts would speedily be laid to rest by an impartial study of its pages. They contain a solid body of information which is of direct value to employers of labor, and to welfare workers and factory inspectors; the practical application of this information to the remedy of adverse industrial conditions would produce a very real improvement in the health and efficiency of the workers. In the analysis of published work with which the report opens the various tests of efficiency and fatigue employed are briefly described, and then a more detailed account is given of the results obtained in various indus-

tries concerning output in relation to hours of labor and the duration of work spells and rest pauses. A subsequent section of the report deals with the impersonal physical conditions of the worker's environment, such as temperature, humidity, ventilation and lighting, and the effects of these conditions on efficiency. Personal factors, such as vocational selection and guidance, time and motion study, and the effects of such conditions as seating and clothing, are treated in considerable detail, whilst a shorter section deals with such matters as organization and the relative importance of human and mechanical factors in efficiency. Most of the sections are illustrated by diagrams reproduced from the published reports of the board, and they show at a glance the hourly and daily variations of output observed under various conditions, the effect of regular rest pauses on output, the improvement of output caused by more adequate lighting and by better ventilation, and the value of certain psychophysiological tests in measuring the skill of compositors. The future of the board is said to be full of promise, for, in addition to the investigations already made in certain branches of the textile, iron and steel, and boot and shoe industries, others are now in progress in the laundry and the pottery industries, whilst application has been made to the board by various trade boards and research associations for the institution of inquiries into several other important industries."

THE MEDICAL FELLOWSHIPS OF THE NATIONAL RESEARCH COUNCIL

As reported briefly in SCIENCE last week, the National Research Council has established fellowships in medicine created for the purpose of increasing the supply of thoroughly qualified teachers in medicine in both clinical and laboratory subjects and in both curative and preventive aspects. The fellowships are supported by appropriations of the Rockefeller Foundation and the General Education Board amounting in total to one hundred thousand dollars a year for a period of five years. Those receiving awards will be known as fellows in medicine of the National Research Council.

To qualify for appointment as a fellow, a candidate must have the degree of doctor of medicine or doctor of philosophy from an approved university, or preparation equivalent to that represented by one of these degrees. Only citizens of the United States or Canada will ordinarily be appointed, although the fellowship board is authorized to set aside this provision in exceptional cases. The fellowships will be open to both sexes.

Since the principal purpose of establishing these fellowships is to increase the number of competent teachers in the field of medicine, each incumbent will be required to gain experience in teaching. As creative work is regarded as essential to the best teaching, emphasis will also be placed upon research.

Fellows will be at liberty to choose the institutions or universities in which they will work, as well as the men under whose direction they will carry on their researches, subject to the approval of the fellowship board.

Appointments are to be made for a period of twelve months, beginning at any time in the year, with an allowance of six weeks for vacation. The time may be extended, however, if in the judgment of the board the work which the fellow has done justifies it. The stipends are not definitely fixed in amount; but they are intended to enable the individual to live comfortably while carrying on his special work as a fellow.

The fellowships will be administered by a special committee, known as the Medical Fellowship Board of the National Research Council.

Correspondence concerning the fellowships should be addressed to the Division of Medical Sciences, National Research Council, Washington, D. C.

INTERNATIONAL CHEMICAL CONFERENCE AT UTRECHT

IN June of last year, Professors Biilmann, Bruni, Ernst Cohen, Donnan, Victor Henri, Kruyt, van Romburgh, Schenk, Walden and Wegscheider met in conference at Utrecht, and agreed to hold there in 1922 a scientific chemical meeting, the date of which is now fixed for June 21, 22 and 23 of this year. The program will consist of several general papers, to-

gether with a number of shorter scientific communications.

This invitation has been sent to those whose names are given in the accompanying list:

America (United States): L. M. Dennis, M. Gomberg, F. G. Keyes, G. N. Lewis, W. A. Noyes, Th. W. Richards, J. Stieglitz, E. W. Washburn, W. R. Whitney.

Czecho-Slovakia: J. V. Dubsky, A. Simek.

Denmark: E. Biilmann, N. Bjerrum, J. N. Brönsted, J. Petersen, S. P. L. Sörensen, Chr. Winther.

Germany: M. Bodenstein, G. Bredig, F. Föster, O. Hahn, A. Hantsch, P. Pfeiffer, R. Pschorr, R. Schenck, Schlenck, A. Stock, A. Wohl, H. Wieland.

France: M. de Broglie, Mme. P. Curie, Darzens, A. Debierne, V. Grignard, Victor Henri, P. Langevin, Ch. Marie, C. Matignon, Ch. Moureau, J. Perrin, G. Urbain.

Great Britain: A. J. Allmand, E. C. Baly, F. G. Donnan, A. Findlay, H. Hartley, W. C. McC. Lewis, F. A. Lindemann, J. W. McBain, W. H. Perkin, N. Sidgwick, F. Soddy, J. Walker.

Italy: A. Angeli, G. Bruni, L. Cambi, A. Miolati, M. Padoa, N. Parravano, G. Plancher, G. Poma.

Holland: H. J. Backer, J. J. Blanksma, J. Böeseken, Ernst Cohen, A. F. Holleman, F. M. Jaeger, H. R. Kruyt, W. Reinders, P. van Romburgh, F. A. H. Schreinemakers.

Norway: H. Goldschmidt.

Austria: E. Abel, J. Biliter, F. Emich, A. Kailan, R. Kremann, A. Klemenc, W. Pauli, F. Pregl, A. Skrabal, R. Wegscheider.

Russia: M. Centnerschwer, W. Ipatiew, N. Kurnakow, Lasarew, Schiloff, L. Tscitschibabin, L. Tsugajew, P. Walden, N. Zelinsky.

Switzerland: E. Baur, P. Dutoit, Ph. A. Guye, F. Fichter, J. Picard, W. D. Treadwell.

Sweden: S. Arrhenius, S. Oden, The. Svedberg.

Professor W. A. Noyes is acting as chairman of the committee to select American members of the conference, the other members being Professor Stieglitz, Professor Lewis and Dr. Whitney.

SCIENTIFIC NOTES AND NEWS

At the annual meeting of the National Academy of Sciences to be held at Washington from April 23 to 26, Dr. Hendrik Anton Lorentz, of the Rijks Universiteit, Leiden, will deliver the evening address on April 24, at the invitation of the Academy and of the Carnegie Institution of Washington.

The general meeting of the American Philosophical Society will be held in Philadelphia on April 20, 21 and 22. At the reception on Friday evening, Dr. Vernon Kellogg, of the National Research Council, will speak on "The Power and Impotence of Man."

Professor Albert Einstein, of the University of Berlin, delivered the first of a series of four lectures in Paris on the "Theory of Relativity," under the auspices of the Collège de France.

Professor A. C. Seward, professor of botany at the University of Cambridge, was elected president of the Geological Society of London at the annual general meeting.

Dr. E. B. Poulton, Hope professor of zoology at the University of Oxford, was elected president of the British Association of Economic Entomologists at the annual meeting, held on February 24.

Dr. B. H. Ransom, chief of the zoological division of the Bureau of Animal Industry, U. S. Department of Agriculture, has been elected a foreign corresponding member of the Royal Academy of Agriculture of Turin, Italy.

Professor Herbert M. Boylston, of the Department of Metallurgy and Mining at the Case School of Applied Science, has been appointed on the Board of the Engineering Foundation for a term of three years as representative of the American Institute of Mining and Metallurgical Engineers.

S. M. Kinter has been appointed manager of the research department of the Westinghouse Electric and Manufacturing Company, succeeding C. E. Skinner, who has been appointed assistant director of engineering in the same company.

Colonel James Milliken has been elected president of the Pittsburgh Testing Laboratory succeeding George H. Clapp, who remains with the organization as a member of the board of directors.

Dr. Bertrand E. Roberts has been appointed epidemiologist of the State Department of

Health in the place of Dr. Edmund Boddy, who has resigned.

DR. GEORGE P. DONEHOO, a member of the American Association for the Advancement of Science, and secretary of the Pennsylvania Historical Commission, has been appointed by Governor W. C. Sproul, state librarian and director of the Pennsylvania State Museum.

DR. ARTHUR S. RHOADS, formerly assistant in forest pathology of the U. S. Bureau of Plant Industry, and more recently of the office of Cereal Investigations and the office of Fruit Disease Investigations of the same bureau, has resigned to accept the position of pathologist at the Missouri State Fruit Experiment Station at Mountain Grove, Missouri.

DR. H. C. BRYANT, economic ornithologist in the Museum of Vertebrate Zoology of the University of California, will again be in charge of the Yosemite Free Nature Guide Service, during the summer of 1922. This service furnished by the National Park Service with the cooperation of the California Fish and Game Commission, aims, through the medium of lectures, field excursions and office hours, to interest and instruct summer visitors in regard to the fauna and flora and the means to be taken to conserve it. During the season of 1921, over 31,000 persons heard lectures and campfire talks, and over 2,200 were given first-hand acquaintance with living things on field excursions.

AT a meeting of the Board of Directors of the Gorgas Memorial Institute, at Washington on April 1, announcement was made that the Panama Government had provided a site for the proposed Gorgas Institute of Tropical and Preventive Medicine. The site is adjacent to the St. Thomas Hospital, which contains laboratories and buildings and represents a cost of approximately $500,000. Dr. Richard Strong, professor of tropical medicines at Harvard University, has been elected director of the institute. The board also announced the selection of the directors of the Gorgas School of Sanitation to be established at Tuscaloosa, Ala. They are: Dr. S. W. Welch, of Alabama; Dr. Charles F. Dalton, of Vermont; Dr. A. J. Chesley, of Minnesota; Dr. E. G. Williams, of Virginia; Dr. Lloyd Noland, medical director of the Tennessee Coal and Iron Company, and J. A. Laprince representing the United States Public Health Service. This board will meet at Tuscaloosa during the last week in May and arrange the courses. At that time they will also probably elect a faculty.

A MEMORIAL to the late Dr. Charles Baskerville, professor of chemistry in the College of the City of New York, who died last January, is planned by the faculty and students of the college. It is proposed that the memorial will take one or more of the following forms: (1) The placing of a bronze tablet on the Chemistry Building, which is to be renamed Baskerville Hall. (2) The founding of a fund to provide for a medal to be called the Charles Baskerville Prize and to be awarded each year to the student doing the best work in chemistry. (3) The establishment of a scholarship to permit students who qualify to pursue courses in advanced chemistry. Subscriptions to the fund should be sent to Professor W. L. Prager of the college.

WE learn of the death on March 19, at Los Angeles, California, of Mrs. Martha Burton Williamson, long a prominent figure in that city, a contributor to the conchological literature of the Pacific Coast, and the donor of a large collection of shells to the Los Angeles City Museum. She had been for many years vice-president of the Historical Society of Southern California.

DR. BENJAMIN MOORE, Whitney professor of biochemistry in the University of Oxford, and formerly professor of physiology at Yale University, died on March 3, at the age of fifty-five years.

DR. AUGUSTUS D. WALLER, professor of physiology and director of the physiological laboratory of the University of London, died on March 11, at the age of fifty-five years.

THE death is announced from Paris, at the age of 84, of the dean of French mathema-

ticians, Camille Jordan, member of the Académie des Sciences, professor emeritus at the Collège de France and the Ecole Polytechnique. He will be particularly remembered for his "Traité des substitutions," which appeared in 1870 and is still to-day the great classic in the theory of finite groups for his "Traité d'Analyse" and especially for his editorship of the *Journal de Mathématiques* in which he followed Resal in 1884, guiding its destinies until this very last year. He had the intense satisfaction of seeing it recently saved from extinction, most probably owing to the strong support that it received from America.

PROFESSOR DR. THEODOR LIEBISCH, late professor of mineralogy at the University of Berlin, died at his home in Berlin on February 9, after a protracted and painful illness. A correspondent writes: "Liebisch was born on April 29, 1852 and from about 1890 to 1900 he was professor of mineralogy at the University of Göttingen. During this period there were many Americans studying for the doctor's degree with their major in chemistry. Most of these men took mineralogy under Professor Liebisch as one of their minors, and it is hardly too much to say that he was one of the most highly respected and best loved professors in the university. He perhaps did more in a personal nature for the American students in those days than did any other professor. All Americans respected and admired him for his deep learning, his ability as a teacher, his inspiration for research work and his extremely kind and ever-thoughtful nature. About the year 1900 he was called to the University of Berlin, and served there until about 1920, when he retired from active work. He was the author of many books, his most important being "Grundriss der Physikalischen Krystallographie."

A GEORGIA ACADEMY OF SCIENCE was organized on March 25 by a group of twenty-two scientific men, invited to the University of Georgia for that purpose. The delegates came from Emory University, the Georgia School of Technology, Mercer University, Oglethorpe University, the University of Georgia and the Georgia Experiment Station. Practically all phases of scientific endeavor were represented. Membership in the academy is to be a recognition of noteworthy service to science or to the scientific development of the state, and the number is limited to fifty. It is the aim of the academy to foster every means of encouraging scientific research, to develop the natural resources of the state, and to stimulate in the people a realization of the fact that their prosperity depends very greatly on the scientific training of a large number of Georgia men.

THE Sigma Xi research fellowships for the coming academic year will be awarded in May. Applications should be made to Professor Edward Ellery, Union College Schenectady, N. Y. The awards are made for work in sciences other than physics and chemistry and to men and women who have already taken their doctor's degree. Applications should be accompanied by reprints of published articles and by reference to two or more persons competent to speak about the ability of the candidate in his or her special line. The minimum award is sixteen hundred dollars.

DR. WILLIAM CROCKER, director of the Thompson Institute for Plant Research, addressed the Brooklyn Institute of Arts and Sciences on March 25 on "The present outlook for plant research in Europe."

DR. W. J. HUMPHREYS, of the U. S. Weather Bureau, recently lectured before the West Virginia University Scientific Society on "Fogs and clouds."

UNIVERSITY AND EDUCATIONAL NOTES

IT is announced that the three million endowment fund for Wesleyan University has been oversubscribed by a hundred thousand dollars.

MR. HAMILTON B. TOMPKINS has bequeathed the residue of his estate to Hamilton College, his alma mater, with a stipulation that $100,000 be set aside for the increase and support of the college library, this fund to be known as the Hamilton B. Tompkins Library Endowment Fund. Five thousand dollars is left to Wells College.

DR. FRANK THILLY, professor of philosophy at Cornell University, and Professor Madison Bentley, professor of psychology in the University of Illinois, will lecture during the summer session of the University of California.

DR. WILLIAM A. R. TAYLOR, now instructor in botany in the University of Pennsylvania, has been promoted to an assistant professorship.

MR. ARTHUR LEE DIXON, M.A., F.R.S., fellow and tutor of Merton College, University of Oxford, has been appointed Waynflete professor of pure mathematics in succession to Professor E. B. Elliott, fellow of Magdalen, who has resigned.

MR. ARTHUR LAPWORTH, D.Sc. (London), F.R.S., at present professor of organic chemistry in the University of Manchester, has been appointed to the Sir Samuel Hall chair of chemistry and to the directorship of the chemical laboratories.

DISCUSSION AND CORRESPONDENCE

GENETICAL ANALYSIS AND THE THEORY OF NATURAL SELECTION

IN my Toronto address I lately referred to John Ray as the first who laid stress on the sterility of interspecific hybrids. I was then writing away from books and must apologise for this slip. The passage in the *Historia Plantarum* 1686, 1, pp. 40 and 42, that I had in mind is probably the first in which anything approaching a genetical definition of species is attempted. Ray there lays down the excellent principle that forms which, though differing from each other, can be bred from seed of the same plant, should be regarded as of the same species. Not till the Linnean period, more than half a century later, did the cognate question of the sterility or fertility of interspecific crosses assume prominence.

Professor Osborn has expressed great vexation at the tenor of my address. After considering his remarks, I do not know that I can add much to what I have said. The divergence between the conceptions to which genetical analysis introduces us and the doctrines of which Professor Osborn has been so long a distinguished champion is indeed wide.

Paleontological observations have served a useful purpose in delimiting the outline of evolution, but in discussing the physiological problem of interspecific relationship evidence of a more stringent character is now required; and a naturalist acquainted with genetical discoveries would be as reluctant to draw conclusions as to the specific relationship of a series of fossils as a chemist would be to pronounce on the nature of a series of unknown compounds from an inspection of them in a row of bottles. The central tenet of Darwinism that species are merely the culminations of varietal differences, such as we find contemporaneously occurring, is not easily reconcilable with the new knowledge. It was my purpose once more to direct the attention of naturalists, especially geneticists, to this deficiency in the evidence, by no means without hope that it may be supplied.

Professor Osborn, in extenuation, suggests that my tongue ran away with me and that I could not have meant what I said. That defense, however, is not available, for I had taken the precaution which I understand he learned from Huxley, and I had prepared a written text. This, in all important passages, I followed verbatim, and it appears without serious modification in SCIENCE for January 20. I may even plead guilty to having spoken and written to the same effect on many previous occasions, and Professor Osborn will find the theme developed in "Problems of Genetics" (New Haven, 1913, and in my presidential address to the British Association in Australia (1914).

W. BATESON

MARCH, 1922

A SUGGESTION TO MR. BRYAN

I THINK most readers of SCIENCE must feel indebted to you as I do for reprinting W. J. Bryan's attack on Evolution. It may be true that only the psychologists will be able to find in it data of value to their science but to them the importance of this contribution of Mr. Bryan's must be large indeed. The rest of us welcome the diversion which it affords. A Don

Quixote of Mr. Bryan's calibre only appears once or twice in a century and the opportunity to study in cold print the celebrated Nebraskan's proposal to resurrect the "special creation of species" myth must be appreciated by our scientific brethren who are interested in studying the mysterious ways in which the human mind sometimes works when it approaches subjects unfamiliar to it.

My principal object in writing you is to suggest that Mr. Bryan should be invited to use the pages of Science to attack an even greater heresy than Evolution. Since Mr. Bryan still gets his biology from the Bible it appears to be a safe inference that he must draw his geography from the same source. Bible geography, or "flat geography" is, I am informed, taught nowadays only in the mountains of eastern Tennessee. Why should not our Bold Knight from Nebraska (or is it Florida?) aim his lance at the teachers of modern or "round" geography and admonish them to hark back to the geography of Joshua? This is perhaps a subject which has been overlooked by this eloquent defender of Biblical science. I can hardly believe it to be lack of courage which has led Mr. Bryan to attack the few and widely scattered teachers of evolution instead of the thousands of teachers of modern geography. Whatever the explanation of Mr. Bryan's neglect to denounce the heresies to be found in the textbooks on geography may be, I beg to suggest that the heretical character of the modern teaching in geography should be brought to the notice of Mr. Bryan.

Edward M. Kindle
Canadian Geological Survey

THE WRITING OF POPULAR SCIENCE

To the Editor of Science: Both Dr. Alfred H. Brooks[1] and Dr. Edwin E. Slosson[2] have recently called attention to the fact that relatively few popular scientific works are being now written in this country; and the former expresses the opinion that there is to-day relatively less popular knowledge of science and less interest in its methods and advancement than there was a generation ago. This opinion will probably be generally accepted as correct. That it should be true in spite of the large amount of scientific work that has been, and is being done, and in spite of the serious attempts of scientific associations and other agencies to create a popular interest in science, indicates that it is high time for scientists to consider seriously themselves, science and the public, in an endeavor to ascertain wherein the difficulty lies. Most scientists will agree with Dr. Brooks that the lack of popular knowledge of science is directly due to the form in which science is presented, and that "what is needed is the presentation of science in a form comprehensible to the educated and thinking man." But to secure such presentation, it is necessary to understand the public, the point of view of those we desire to reach, the mental background with which the science we present must be harmonized; to understand science and ourselves; to keep in mind what constitutes science; to have a clear idea of what we wish to give the public. Otherwise we are in danger of merely groping blindly, and of, perhaps often, prostituting the name of science.

We all acknowledge that science is *organized* knowledge. That neither an isolated fact, nor an infinite number of isolated facts, is science; no matter how true and exact the facts may be. It is only when two or more facts are seen to be related, that science comes into existence. Science does not consist of facts, but of recognized relations between facts. Science is essentially a mental phenomenon[3].

But are there not, only too often, offered under the guise of science mere isolated facts trimmed with sufficient allegory and superficial analogies to fill a respectable amount of space and to attract the layman's attention? This is not science, but merely information—the raw material out of which science is made.

[1] *Journal Wash. Acad. Science*, 12: 73-115, 1922.

[2] Science, 55: 241, 1922.

[3] Since this was written Dr. F. L. Hoffman's admirable vice-presidential address (Science, March 10), entitled "The Organization of Knowledge" has come to my attention. In this, the essential distinction between mere facts and science is strongly emphasized.

It has no cultural value other than what the reader can supply by coordinating it with other information that he has acquired from other sources. Only by, and to the extent of, such coordination does the fact become scientific.

Is it not here that the scientist needs to consider both himself and his reader? For him, this fact he offers has a wealth of associations; he sees it in its relations to numerous other facts; the mere fact that this particular fact *is*, has for him far-reaching implications; it is against such a rich and harmonious background that *he* sees the fact. But with the layman it is far different; he can furnish but a meager background, often merely a dead black drop. The fact as presented with its allegory and analogy may appear to him very beautiful, or wonderful, or surprising, but it does not mean anything to him. Is it surprising that he does not enthuse over it? A person likes to feel that he is getting somewhere. An article that establishes a recognized relationship between two or more facts meets this desire, and by the serious minded public would surely be received more favorably, than one that merely retails information.

But the choosing and presenting of a relation between facts is difficult. The scientist is embarrassed by the complexity of the relations that he recognizes; what portion of the vast web shall he choose? And having chosen, how can he supply the proper surroundings to give it in any fair degree its true significance when seen against the drab background that will be furnished by the reader? To succeed, he must know how to present his facts and arguments so that they will fit into his reader's experiences and habits of thought. He must be acquainted with his reader. Is it not here that the great difficulty lies? The scientist of this country seldom has the leisure, and often has not the inclination, to become really acquainted with the experiences and the mental processes of the non-scientist. As a result, he is unable to present his scientific knowledge in a form that is readily understandable by the layman.

The remedy is to be found in a more intimate acquaintance of the scientific and the non-scientific classes with one another. In the endeavor to secure such improved acquaintance, the scientist is called upon to take the initiative, and to do the most. He must cultivate the acquaintance of the non-scientist; must study him; must show him, in a way that he can understand, what science really is; must make him see that scientific work does not consist in merely collecting wonderful, interesting, or surprising facts and observations, nor in inventing useful or weird contrivances, but in ascertaining how facts are related to one another, so that he may be able to forecast with confidence the results that will follow from a given act, and conversely, may be able to specify what set of acts will give a desired result. The non-scientist must be made to see that science does not consist in making inventions, but in furnishing the raw materials out of which inventions are made. Once get the army of non-scientists to understand these things, and the securing of their interest in science and its advancement will cease to be a problem.

The public can learn what science is, only by being shown properly labeled examples of it. These must be understandable, but nevertheless must be real and rigid science; and in no case should the reader be relieved of all necessity for thinking. Among the types of subjects that appear to be suited to this purpose are: (1) Accounts of discoveries, in which the reason for undertaking the work and the main steps in the establishing of the conclusions are given. (2) Accounts of experimental research, or of precise measurement, in which the line of reasoning, illustrations of check experiments, etc., are given. (3) Accounts of experiments designed to established suspected relationships between observed facts. Unsuccessful experiments should not be ignored. (4) Accounts of the establishing of relationships between observed facts by purely inductive methods.

If we would avoid giving the public a false idea of what science really is, let us discourage the practice of placing the label "science" on presentations of mere isolated facts, and let us clearly inform the public, by word as well as by example, that science consists in the es-

tablishing of relations, not in the cataloguing of facts.

N. E. DORSEY

404 MARYLAND BUILDING,
WASHINGTON, D. C.

QUOTATIONS

THE EARNING POWER OF RESEARCH

A FEW years ago the X-ray tube was an erratic apparatus not in any very general use. The research laboratory of the General Electric Company realized that there was a possibility of utilizing pure electronic emission from a hot filament to produce controllable X-rays in a perfect vacuum. They conducted extensive research upon such devices as then existed, and as a result the tungsten target took the place of platinum in the standard gas tube of that day. Research had also to be applied before the laboratory learned positively that available electrons already existed and that there was a possibility of controlling them, as, for example, focusing them on a target. The research has been continued, until today practically all the X-ray tubes of the country are made by the company in accordance with the discoveries of the man whose name the tubes bear. The Coolidge tube is also used abroad almost to the exclusion of other types. These remarkable results have been achieved through very careful, accurate, and often discouraging studies of electric phenomena in high vacua, with very pure materials. The perfection of the tube is the nucleus of an annual business, including accessories and generating apparatus used in X-ray work, of from five to ten million dollars a year. The benefit cannot be measured wholly in monetary return, for everyone is familiar with the humanitarian benefits.

Our oldest industries have been the most reluctant in establishing research laboratories. But the experience of a leader may guide the entire industry. Some years ago the Ward Baking Company established a fellowship at the Mellon Institute. The research soon brought results and the application of a more balanced yeast nutrient to the dough gave better fermentation and better bread. It was discovered that the baker can grow yeast in the dough and control fermentation wastes. This conservation amounts to 2 per cent of the flour, 15 per cent of the sugar, and sufficient yeast to make the total saving 45 cents net per barrel of flour used. It is estimated that this process saves American, Canadian, and British bakers not less than $40,000 per day, without detriment to the quality of the bread.

In 1915 a control laboratory was installed with one chemist. Today there are a variety of control laboratories with twenty-five technical workers. A chemist has frequently saved two months' salary for his employer with a report on samples from a single carload of butter. The control which has been established as a result of research upon the raw materials makes possible uniformity in the finished product. Time, temperature, and other factors which influence fermentation have been established, and since no two carloads of flour are alike the data are vital in determining how fermentation must be varied to secure uniformity. The study of enzymes, proteins, colloids, yeasts, bacteria, and nutrient value is pointing the way to still better bread, higher nutritive values, economy in production, and the elevation of the entire industry. It is no wonder that during these days of industrial depression this pioneer in research as applied to baking has increased the number of its scientific workers. Results continue to justify the increase.—*The Journal of Industrial and Engineering Chemistry.*

SCIENTIFIC BOOKS

A Monograph of the Existing Crinoids. Volume 1. The Comatulids. Part 2. By AUSTIN HOBART CLARK, Curator, Division of Echinoderms, United States National Museum. Bulletin 82. Washington, 1921. 4 to Pp. xxvi + 795; with 949 text-figures and 57 plates.

THE first part of Clark's monograph appeared in 1915.[1] The present brochure, fully twice the size of its predecessor, constitutes the concluding part of the general introduction to The Comatulids. The systematic description of the group will follow. The major part of this work has already been completed and much of it has appeared in a series of monographs and

[1] Reviewed in SCIENCE, N. S., Vol. XLII, No. 1080, p. 342, Sept. 10, 1915, by Frank Springer.

shorter papers which have supplied the first adequate account of the free crinoids. It has been no mean task, for when Mr. Clark tackled the problem, the classification of the comatulids was in a state of hopeless confusion. The resolution of this chaos into a system was a brilliant piece of analysis and construction, and constitutes a notable achievement in the field of animal taxonomy. The present volume contains an enormous amount of detail, and maintains the high standard of Part 1. It has a wealth of illustration—no less than 1,364 figures, the greater part drawn by the author, as there are few photographs. Such figures as have been taken from previous authors have in almost all cases been retouched by Mr. Clark to bring out points previously overlooked or misinterpreted. Nine hundred forty-nine drawings appear in the text.

What might be termed the background of the work has been stated by Mr. Frank Springer in his review of Part 1, and need not therefore be recounted here. The present volume contains a very large amount of entirely new and original matter. It begins by taking up the description of the radials of the comatulids at the point at which it was left at the end of Part 1. The articular faces of the radials of 52 species are described in detail from dissections preserved in the collection of the National Museum and reference is made to the 20 described more or less satisfactorily by previous authors. The whole subject of the structure, relationships, physiology and homologies of the socalled post-radial structures (arms and pinnules) is exhaustively treated. All of this matter is original and is based upon specimens in the National Museum. The perisomic plates, or those developed within and entirely confined to the ventral surface, come in for detailed description for the first time, the subject being handled in an entirely new way; and the sideplates and covering-plates of the pinnules of 203 species in the National Museum collection are also treated.

A complete and detailed account of the anatomy, embryology, and regeneration of the comatulids is given. There is at present no single source from which this information can be derived, as it is widely scattered through a great number of usually short papers in various languages.

The spawning season of 24 species is given; previously that of only 4 species was known.

The pentacrinoid young of 28 species are described and the first comparative account of the pentacrinoids is given.

A considerable amount of information is assembled concerning the habits, reactions to various stimuli and food, concerning which up to the present there has been no adequate source of information.

All of the numerous parasites and commensals on the crinodis are listed and when necessary for comparative purposes, many of those occurring on other echinoderms. Parasitism and commensalism among marine invertebrates has been greatly neglected and this section therefore forms an important contribution to the subject. Incidentally, a detailed account of the myzostomes, almost exclusively parasitic on the crinoids, is given, together with a complete list of all the known species. No other list exists at present.

The coloring of the comatulids, remarkable for its brilliancy and diversity, is treated in detail for the first time, the color of 160 species, in many cases from the author's own notes taken at sea, being given. The pigment is described and the chemical composition of the skeleton is discussed.

Such, in bare outline, are the contents of an extraordinarily well conceived and thoroughly executed treatise, upon the publication of which the author as well as the authorities of the National Museum are to be congratulated, for the work will always remain a point of departure for future investigation.

The press-work of this volume is excellent and an improvement over that of Part 1. The half-rag paper is also a decided advance, although really too thin to carry the larger text figures, since the printing on the reverse shows through. A few copies of such fundamental memoirs as the present should be printed upon heavy, full-rag paper, or better still upon linen, and deposited in, say, half a dozen "strategic" libraries of the world. Too many of our basic

monographs are printed upon paper which will be relatively short-lived.

W. K. FISHER.

SPECIAL ARTICLES

A NEW VARIETY OF BARLEY WITH STRIKING CHARACTERISTICS

THE new variety of barley, which the writer has provisionally called Mack's Branched barley, has never been recorded in literature heretofore. It was discovered by Mr. J. M. Mack, of Fallbrook, California, in a wheat field mixed with much barley. Specimens of the new form were sent to the University of California in 1921 for further investigation; and the writer has been much interested in it in connection with his genetic studies in barley. It is a six row barley possessing the following characteristics:

1. An Increase in the Number of Nodes accompanied by an irregular Shortening of Internodes. The number of nodes in ordinary varieties of barley varies from three to seven, the uppermost internode below the spike being always the longest; while Mack's Branched barley has from 10 to 30 nodes on each tiller without elongation of the uppermost internode. The shortening of the internodes and the increase in the number of nodes make the straw much stiffer; and indeed the variety would be most resistant to lodging if not for the fact that too heavy a weight is carried at the upper portion as a result of branching.

2. The capacity to Branch at Any Node. Tillers arise from the first node at the bottom in ordinary cultivated barleys. Wessling barley has a branched spike, but the branching is confined to the head. No form has been recorded heretofore as branching freely at any node and also capable of secondary and tertiary branching, which is a characteristic of Mack's Branched barley.

3. The capacity to Produce Roots at any Node. Although it is possible to induce some of the common varieties of barley to produce roots at nodes near the base, the setting of roots at the upper nodes when covered with soil is quite a unique character possessed by this form alone.

4. The Capabilitay of Vegetative Propagation. The fact that this variety of barley is capable of branching and rooting at every node suggested to the writer the possibility of vegitative propagation. Abundant roots were secured by the layerage method in a period of 2 weeks in the open field in January. Cutting off a tiller and transplanting it in a pot in the greenhouse has resulted in slower recovery than in the case of mount layerage; but nevertheless a main root has arisen from a node near the place of cutting and hence it is reasonably sure that the cutting will succeed as a separate plant.

The possibility of vegetative propagation of this cereal is of considerable scientific interest, if it is not yet of practical agricultural interest. This new form is of appreciable value especially to those interested in genetic studies of barley, because it makes possible the continuous propagation of the heterozygote. This will make backcrossing in barley as a means of genetic investigation more practical, although it is still doubtful whether backcrossing can be extensively employed in this cereal, the process of artificial fertilization being so tedious in contrast with the ease of growing self-fertilizing hybrid generations.

Although the new form is apparently of no agricultural value by itself, yet the branching and cold resistant characters may be utilized to advantage by hybridization with some of the commoner types of cultivated barley.

Nothing is yet known concerning the origin of this interesting form, as it was discovered in a mixed field. All that we know is that its striking characteristics are constant and breed true under the different environmental conditions to which it has been subjected. The writer plans to make a number of crosses between this form and several of the cultivated varieties in the coming spring, as this interesting barley certainly deserves an intensive genetic study.

KWEN S. HOR
UNIVERSITY OF CALIFORNIA

[1] *Phil. Mag.*, s. 5, Vol. 24, p. 87.
[2] *Phil Mag.*, s. 5, Vol. 24, p. 423.

THE FEDERATION OF AMERICAN SOCIETIES FOR EXPERIMENTAL BIOLOGY

THE Federation of American Societies for Experimental Biology, which comprises the American Physiological Society, the American Society of Biological Chemists, Inc., the American Society for Pharmacology and Experimental Therapeutics, and the American Society for Experimental Pathology, met for their annual scientific program, December 28-30, 1921, under the auspices of Yale University. Two joint scientific sessions were held. The first joint session was called at 9:30 on the morning of December 28 under the presidency of Dr. J. J. R. Macleod of the Physiological Society. Twelve scientific papers representative of the research work of the four societies were presented and discussed at this session. An equally strong joint session was held at the close of the third day, beginning at two o'clock on December 30 and consisting of eleven papers. Sessions of the individual societies filled the remaining four periods of the meeting.

The executive committee of the Federation is composed of the presidents and secretaries of the four constituent societies as follows: J. J. R. Macleod, executive chairman; C. W. Greene, secretary; D. D. Van Slyke, C. W. Edmunds, F. G. Novy, V. C. Myers, E. D. Brown and Wade H. Bown. The first executive committee meeting was called at 4:30 p.m., December 27, at which time the following business was transacted. The report of the treasurer of the Information Service Fund, Dr. Joseph Erlanger, was presented showing a net balance of $312.34. The secretary of the Information Service presented the annual report showing progress during the year. This appointment service undertakes to call to the attention of universities and scientific institutions and others the availability of scientists in the different technical lines represented by the societies. The late Dr. S. J. Meltzer, who keenly appreciated the difficulties confronting the young men preparing in science in the way of securing information of openings in their lines, and the equal difficulty met by institutions in finding men of scientific preparation and fitness in particular lines, contributed the original fund to meet the expenses of this activity. It is the hope of the Federation that increasing use of this institution will be made through the secretary, Professor E. D. Brown, of the University of Minnesota.

The problem of correlation of overlapping programs as between the Federation and the American Association for the Advancement of Science, together with the desirability of holding periodical joint meetings, was presented and discussed. Such cooperation was favored by the Federation. Informal discussion was had of the necessity of the appointment of a permanent secretary to care for the increasing general business of the Federation. This was referred to the incoming executive committee.

The most important act of the Federation was the presentation and discussion of a resolution calling attention to the decreasing supply of young men entering the pre-clinical medical sciences. The general discussion tended to show that aside from the effects of reconstruction activities, there are certain special causes operating to deter young men from choosing the biological sciences even though attracted by their intrinsic interest.

It was recognized that there is always the need of giant personalities and great teachers who stimulate and lead young men by an attractive presentation of the science itself. However, the financial advantages and the secondary rewards of a professional career too generally outstrip the financial income and perquisites of research and teaching in the biological sciences. Scientific investigators do not expect great financial returns but they do have a right to sufficient income from their activities to avail themselves of the usual journals, meetings, and other necessary instruments for scientific work. The standards of maintenance of the social and family position of the scientist and the education of his children are well defined. Many teachers hesitate to urge upon their brilliant students careers which do not of themselves guarantee this degree of support. The net result is that it takes an idealistic temperament with a cer-

tain amount of utopianism to adopt as a life work scientific professions which involve so much of sacrifice to person and family.

In recent years also there seems to be a tendency in educational and scientific institutions to break away from the recognized paths blazed by the trained and conservative leadership of those who have made the present standing of the basal medical sciences in America. It is admitted that academic ruts may become established which may possibly best be eradicated now and then by drastic innovations. But the question is raised whether the rewards of promotion in rank and of calls to institutions of recognized leadership have not too often been made on the basis of some special demand which for the time being has swayed the control in these institutions. The break in morale is the same in science as would occur in business or military organizations when awards fall too frequently outside the groups of seniority in leadership and scientific attainment.

The executive committee after confirmation by the constituent societies approved and passed the following resolution with instruction that the same should be published and by other means called to the attention of administrators and others responsible for scientific appointments in American institutions.

Resolution of the Federation of American Societies for Experimental Biology

Adopted December 30, 1921

The Federation of American Societies for Experimental Biology, comprising the American Physiological Society, the American Society of Biological Chemists, Inc., the American Society for Pharmacology and Experimental Therapeutics, and the American Society for Experimental Pathology, as the official body representing workers in these various fields, feels that it is its duty to call the attention of the authorities of our universities and endowed foundations, of the medical profession and others, to the grave situation now existing in respect to recruits in these branches of biological and medical science.

1. A country-wide investigation, recently published, has revealed that the number of young men of ability entering on careers in the sciences basal to medicine and surgery is inadequate to fill the available positions.

2. This condition is due to two factors:

a. The number of positions in the preclinical sciences in universities and other institutions has increased more rapidly than the number of men entering these fields; and

b. The improvements and increased opportunities for laboratory investigation in clinical subjects, together with the greater remuneration in clinical departments, have made such positions relatively more attractive. In response to the urgent demand for men of scientific training to fill clinical posts, many are becoming clinicians who under former conditions would have remained in the preclinical sciences. With the increasing growth of scientific medicine it becomes evident that the only clinical teachers and investigators competent to carry forward modern medicine are those who have had sound training and experience in one or more preclinical sciences and have later acquired clinical skill and judgment.

3. The great contributions to knowledge and human welfare which the sciences represented in this Federation will make, is to be determined by the number of able workers in these sciences. An adequate application of physical sciences to biological and medical problems will come only from the broadest development of physiology, biochemistry, pharmacology and pathology; and the aid of these sciences in the progress of clinical medicine will largely depend upon the ability of these departments in our universities to supply the basic training to those who later enter upon clinical work. They must therefore furnish the recruits both for their own laboratories and for the clinics; failure to do so will prevent the progress now underway.

The Federation submits these facts to the thoughtful consideration of university authorities, and strongly recommends that immediate efforts be undertaken to improve the status and facilities of the basal medical sciences, so as to increase the number and ability of the recruits drawn to these sciences.

The cordial invitation of the University of Toronto to hold the next annual meeting of the Federation in the halls of that institution was accepted and it was ordered that the annual meeting for 1922 be called at the University of Toronto, Toronto, Canada, December 28-30, 1922.

Chas. W. Greene,
Secretary of the Executive Committee